Lab 3; Normalization

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1,
R(A,B,C,D,E,F)
FD1: A -> BC
FD2: C->AD
FD:3 DE->F

a)
decomposition on FD2, FD4: C->A
transitive rule on FD1 and FD4, FD5: C->BC
decomposition on FD5, FD6: C->B

b)
decomposition on FD1, FD7: A->C
transitive rule on FD2 and FD7, FD8: A->AD
decomposition on FD8, FD9: A->D
augmentation rule on FD9, FD10: AE->DE
transitive rule on FD10 and FD3, FD11: AE->F

2,

a)
We set X = {A} = X+
First iteration : X+ = {A,B,C} (FD1)
Second iteration X+ = {A,B,C,D} (FD2)
Since E does not exist in the closure the last FD can not be resolved.

b,
We set X = {C,E} = X+
First iteration : X+ = {C,E,A,D} (FD2)
Second iteration X+ = {C,E,A,D,B} (FD1)
Third iteration X+ = {C,E,A,D,B,F} = R (FD3)

3,
FD1: AB->CDEF
FD2: E->F
FD3: D->B

a,
Since A only exists on the left side of the functional dependencies we know that it has to be a part of the candidate key. Since C and F only exists on the right side we know that they can not be part of the candidate key.

possible superkeys: {A,B}, {AD}, {A,E}
{A,B}+ = {A,B,C,D,E,F} (superkey)
{A,D}+ = {A,B,C,D,E,F} (superkey)
{A,E}+ = {A,E,F}(not super key)

Since only superkeys can be candidate keys and our superkeys are not subsets of each other both are candidate keys. If we try each attribute (A,B and D) individually we don't have a superkey and thus makes the superkeys above candidate keys.
Ck = {A,B}, {A,D}

b,
E->F and D->B

c,
We divide R into R1 and R2 by decomposing R with FD2.

R1(E,F)
FD2 : E-> F
CK={E}
in BCNF

R2(A,B,C,D,E)
FD4: AB->CDE (decomposition rule on FD1)
FD3: D->B
CK={AB}
not in BCNF

Now we do it again on R2 and decompose into R3 and R4 with FD3:
R3(D,B)
FD3: D->B
CK={D}
in BCNF

R4(A,C,D,E)
with no FD and CK={A,C,D,E}
in BCNF

4,
R(A, B, C, D, E)
FD1: ABC -> DE
FD2: BCD -> AE
FD3: C -> D
a)

B and C only exist on the LHS which means that they are a part of the candidate key. E is only on the RHS which makes it not a candidate key

Possible combinations:
{A,B,C}+={A,B,C,D,E}(superkey)
{B,C,D}+={A,B,C,D,E}(superkey)

By trying to reduce the superkeys to only BC we don't get a superkey, which makes previous mentioned superkeys candidate keys.
CK={A,B,C}, {B,C,D}
FD3 violates BCNF since it is not a superkey.

b,
We divide R into R1 and R2 by decomposing R with FD3.

R1(C,D)
FD3: C->D
Ck = {C}
in BCNF

R2(A,B,C,E)
FD4: ABC-> E (decomposition rule on FD1)
Ck = {A,B,C}
in BCNF